INSTITUTO SUPERIOR TÉCNICO
Universidade Técnica de Lisboa

# Electrónica das Interfaces

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# Outline

- Goal and objectives
- Program
- Course Meeting Times
- Homework
- Grading procedure
- Textbooks and Materials

# Goal and objectives

## Goal

- This course aims to develop skills to analyze and design reliable interfaces for high speed circuits and systems.

## Objectives

Upon completion of the course, students will be able:

- To understand concepts and terms associated with signal integrity.
- To be aware of signal integrity problems in: high speed equipment interconnections, PCB design and IC design.
- To know how to minimize signal integrity problems.
- To know design rules and guidelines to avoid EMC.
- To be able to design interconnections in blocks, circuits and systems.

# Goal and objectives

Demonstration of concepts designing a high-speed printed circuit board (PCB)

# Program

Interconnections

- The importance of interconnection design. Brief history. Interconnecting using cables, on a PCB or inside an IC. Emerging technologies.

Signal integrity

- Fundamental concepts in high frequency interconnection design. Signal quality on a net. Noise: reflections due to discontinuities, switching, crosstalk, voltage supply circuit, electromagnetic interference, etc.

Crosstalk

- Mutual inductance and mutual capacitance. Capacitive and inductive coupling. Induced noise. Minimization of crosstalk. Differential interfaces.

Transmission lines and terminations

- Shortcomings of Point-to-Point wiring. Transmission line equivalent circuit. Reflections. Terminations. Active terminations.

# Program

## Interconnections

- The importance of interconnection design. Brief history. Interconnecting using cables, on a PCB or inside an IC. Emerging technologies.

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# Program

Vias, connectors, cables and packages

- Mechanical properties of vias. Connectors: series inductance, mutual inductance, shunt capacitance and parasitic capacitance. Electromagnetic interference. Connectors for differential interfaces. Cables (ribbon/flat): signal propagation and electromagnetic interference. Effects of a package

Power and ground distribution

- Stability of voltage reference. Uniform voltage distribution. Bypass capacitors. Ground planes. Guard traces. Layer stacking

Clock distribution

- Clock Skew. Use of Low Impedance Drivers. Source Termination of Clock Lines. Differential Distribution.

# Program

Electromagnetic Compatibility

- EMC fundamentals: definitions, electrical dimensions and EMC measurement units. Electromagnetic compatibility in electronic circuits. Susceptibility and radiation. Standards.

# Course Meeting Times

- Lectures:

  Two sessions / week
  1.5 hour / session

- Labs:

  One session / week
  1.5 hour / session
  Attendance is mandatory
  Groups: 2 students

# Homework

- Students should expect to work on its project during class time, but this will probably not be sufficient to complete the projects on time.
- Students should expect to spend extra time working on its project.

# Grading Procedure

- PCB design design project: 50%
  - 1st Milestone - Individual demonstration of capability to use CAD software: March 23rd
  - 2nd Milestone - Schematic diagram with report: April, 27th
  - 3rd Milestone: Final report June, 1st
- Final examination: 50%
  - 1st date: June 22nd
  - 2nd date: July, 6th
- Minimum 9,5 (both PCD design and examination)

# Textbooks and Materials

1. Howard W. Johnson e Martin Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993
2.

   Howard W. Johnson e Martin Graham, High Speed Signal Propagation: Advanced Black Magic, Prentice Hall, 2003

   Stephen H. Hall, Garrett W. Jall e James A. McCall, High-speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, John Wiley and Suns, 2000

   Eric Bogatin, Signal Integrity – Simplified, Prentice Hall, September 2003

   Paul R. Clayton, Introduction to Electromagnetic Compatibility", Wiley-Interscience, 2006

# Textbooks and Materials

3. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and Layout, Elsevier, 2007

4. Links